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(54) BASE SHEET FOR ELECTRONIC APPARATUS MADE OF NICKEL
PLATING ALUMINUM BASE COMPOSITE MATERIAL AND ITS PRODUCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a base sheet capable of obtaining good

solderability, free from the excessive spread of solder and exhibiting suitable solder wettability by plating the surface of an aluminum base composite material with an Ni metallic layer or an Ni-P alloy layer to the thickness above the specified one as a substrate and plating the surface with Ni-Co, Ni-Co-B and Ni-B alloy layers to the thickness above the specified one as surface layers.

SOLUTION: The surface of an aluminum base composite material is plated with an Ni metallic layer or an Ni-P alloy layer to $\geq 3 \mu\text{m}$ thickness as a substrate, and the surface is preferably plated with one or more kinds among an Ni-Co alloy layer, an Ni-Co-B alloy layer and an Ni-B alloy layer to $\geq 0.01 \mu\text{m}$ thickness as surface layers. Next, it is subjected to deaerating treatment of executing heating at a temp. rising rate of $\leq 200^\circ\text{C/hr}$ in a reducing or nonoxidizing atmosphere or in a vacuum and executing holding at 200 to 500°C for a prescribed time. The substrate increases the adhesion of the surface layers with the aluminum base composite material and improves the corrosion resistance of the aluminum base composite material, and in the surface layers, good solderability can be obtd.

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CLAIMS

[Claim(s)]

[Claim 1] The base plate for the electronic equipment made from nickel plating
aluminum radical composite characterized by for nickel metal layer or a nickel-P
alloy layer being galvanized as a substrate layer on aluminum radical composite
by 3 micrometers or more in thickness, and at least one layer in a nickel-Co alloy
layer, a nickel-Co-B alloy layer, or a nickel-B alloy layer being galvanized as a
surface layer on it by 0.01 micrometers or more in thickness.

[Claim 2] nickel metal layer or a nickel-P alloy layer is galvanized in thickness of
3 micrometers or more as a substrate layer on aluminum radical composite. At
least one layer in a nickel-Co alloy layer, a nickel-Co-B alloy layer, or a nickel-B
alloy layer is galvanized in thickness of 0.01 micrometers or more as a surface
layer on it. Subsequently in a reducing atmosphere, a non-oxidizing atmosphere,
or a vacuum The manufacture approach of the base plate for the electronic
equipment made from aluminum radical composite characterized by performing
degassing processing which heats with the programming rate of 200 degrees C

or less per hour, and carries out predetermined time maintenance at the temperature of 200-500 degrees C.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the base plate for the electronic equipment made from nickel plating aluminum radical composite with which good soldering nature is obtained and solder does not spread too much and in which moderate solder wettability is shown, and its manufacture approach.

[0002]

[Description of the Prior Art] It is the large capacity IGBT (Insulated Gate Bipolar Transister) which is easy to generate heat recently taking advantage of the features of the low-feeve expansibility and high temperature conductivity although aluminum radical composite is the composite which made aluminum or an aluminium alloy distribute SERAMMIKUSU, carbon, etc. of the shape of fibrous or a particle and has been used for the field which requires reinforcement and abrasion resistance conventionally. It began to be adopted as the modular

substrate etc. By the way, although the DBC substrate (Direct Bonding Copper: substrate which covered Cu to the ceramic plate) carrying Si chip etc. is soldered to said substrate, since aluminum radical composite has bad soldering nature, nickel was galvanized into the soldering part of aluminum radical composite, and soldering nature has been improved (JP,5-86481,A).

[0003] However, although a detrimental oxidation coat will generate in soldering if said nickel plating layer is left about one week in atmospheric air, this oxide film is removed by the chlorine-based flux applied at the time of soldering, and soldering is made almost good. By the way, from the field of environmental protection, it tends to refrain from use, low chlorine-based flux and the flux which uses turpentine as a principal component come to be used instead of it, and, as for said chlorine-based flux, the non flux soldering method soldered all over a hydrogen gas ambient atmosphere furnace, the mixed-gas ambient atmosphere furnace of nitrogen and hydrogen, or an inert gas ambient atmosphere furnace is further developed from it in recent years, without using flux.

[0004]

[Problem(s) to be Solved by the Invention] However, since there is no deacidification like chlorine-based flux, when an oxide film exists, there is a problem that solder wettability falls and soldering nature gets worse in said non flux soldering method. For example, if a DBC substrate is soldered in a reducing atmosphere (hydrogen-10vol% nitrogen) furnace using eutectic solder (Sn-37wt%Pb) after leaving nickel plating aluminum radical composite for one week in atmospheric air, the part non-joining (it does not get wet) and the part in which a fillet (padding part of solder) is not formed will actually be generated at works. For this reason, the good surface treatment approach of solder wettability is studied briskly. On the other hand, when solder wettability is too good, in order for solder to spread even to the field which makes solder unnecessary and to cause the fall of a poor appearance and a function, a mask is carried out by resists (epoxy resin etc.), the breadth of solder is stopped, and there is a problem that productivity is checked.

[0005] Since it was such, this invention person etc. inquired about the surface treatment approach of aluminum radical composite which shows moderate solder wettability that good soldering nature is obtained and solder does not spread too much in a non flux soldering method, did the knowledge of moderate solder wettability being obtained by as a result galvanizing predetermined nickel alloy to aluminum radical composite, advances research further and came to complete this invention. This invention aims at offer of the base plate for the electronic equipment made from nickel plating aluminum radical composite with which good soldering nature is obtained and solder does not spread too much and in which moderate solder wettability is shown, and its manufacture approach.

[0006]

[Means for Solving the Problem] Invention according to claim 1 is a base plate for the electronic equipment made from nickel plating aluminum radical composite characterized by for nickel metal layer or a nickel-P alloy layer being galvanized as a substrate layer on aluminum radical composite by 3 micrometers or more in thickness, and at least one layer in a nickel-Co alloy layer, a nickel-Co-B alloy layer, or a nickel-B alloy layer being galvanized as a surface layer on it by 0.01 micrometers or more in thickness.

[0007] Invention according to claim 2 galvanizes nickel metal layer or a nickel-P alloy layer in thickness of 3 micrometers or more as a substrate layer on aluminum radical composite. At least one layer in a nickel-Co alloy layer, a nickel-Co-B alloy layer, or a nickel-B alloy layer is galvanized in thickness of 0.01 micrometers or more as a surface layer on it. Subsequently in a reducing atmosphere, a non-oxidizing atmosphere, or a vacuum It is the manufacture approach of the base plate for the electronic equipment made from aluminum radical composite characterized by performing degassing processing which heats with the programming rate of 200 degrees C or less per hour, and carries out predetermined time maintenance at the temperature of 200-500 degrees C.

[0008]

[Embodiment of the Invention] In invention according to claim 1, the substrate

layer of nickel metal galvanized on aluminum radical composite or a nickel-P alloy raises adhesion with the aluminum radical composite of a surface layer, and improves the corrosion resistance of aluminum radical composite by galvanizing all over aluminum radical composite further. Moreover, said surface layer consists of at least one sort of a nickel-Co alloy layer, a nickel-Co-B alloy layer, or a nickel-B alloy layer, and shows the moderate solder wettability in which soldering nature with any good alloy layer is obtained, and solder does not spread too much.

[0009] In 5 - 15wt%, the effectiveness as the substrate layer is the best, and the content of P of the nickel-P alloy layer of said substrate layer is demonstrated. Moreover, in 1 - 5wt%, the effectiveness as a surface layer is the best and the content of Co in the nickel-Co alloy layer, nickel-Co-B alloy layer, or nickel-B alloy layer of a surface layer and B is demonstrated 10 - 30wt%, respectively.

[0010] In this invention, the reason for specifying the thickness of said substrate layer to 3 micrometers or more is because there is a possibility of the base of aluminum radical composite being exposed in less than 3 micrometers, and stopping achieving the duty as a substrate layer, and is especially desirable. [of the thickness of 5 micrometers or more] On the other hand, since thermal resistance will increase, and heat dissipation nature will fall and it will also become the cause of a cost rise if a substrate layer is too thick, 20 micrometers or less are desirable. In this invention, the reason for specifying the thickness of said surface layer to 0.01 micrometers or more is because that effectiveness is not fully acquired in less than 0.01 micrometers, and especially desirable thickness is 0.02 micrometers or more. Even if the thickness of a surface layer is thicker than 5 micrometers, the effectiveness is saturated, it is uneconomical and its 5 micrometers or less are desirable. The same effectiveness is acquired even if it forms said surface layer by two or more alloy layers. Moreover, even if it forms a lower layer by nickel metal layer and the nickel-P alloy layer, it does not interfere.

[0011] in this invention, aluminum containing alloys of arbitration, such as pure

aluminum or an aluminum-Si alloy, and an aluminum-Mg alloy, use for the aluminum used as the matrix of aluminum radical composite -- having -- moreover -- distributed material -- SiC, AlN, ZrO₂, Si₃N₄, and SiO₂ etc. -- fiber or particles, such as ceramics or carbon, are used, and the combination of said aluminum alloy and distributed material is arbitrary. Since the coefficient of thermal expansion is small, when said aluminum radical composite was excellent in thermal conductivity, and it is used as an electronic equipment base plate, stripping of the generation of heat of electronic equipment is carried out good. Since especially both aluminum-Si alloys and carbon fiber have a small coefficient of thermal expansion and approximate mutually, aluminum radical composite constituted by both has [that it is hard to produce peeling between aluminum matrix and distributed material] the high dependability of aluminum radical composite. Moreover, since an aluminum-Si alloy has good fluidity nature, quality aluminum radical composite is obtained. As distributed material with a small coefficient of thermal expansion, fiber (particle), such as SiC, AlN, ZrO₂, etc. besides carbon fiber (particle), is mentioned.

[0012] After invention according to claim 2 galvanizes a substrate layer and a surface layer on aluminum radical composite, it is the manufacture approach of the base plate for the electronic equipment made from nickel plating aluminum radical composite which carries out degassing processing on a reducing atmosphere, a non-oxidizing atmosphere, or heating conditions predetermined in the inside of a vacuum (that is, the plating liquid which permeated aluminum radical composite is remove), and according to this manufacture approach, a surface layer does not deteriorate but moderate solder wettability is obtain. A hydrogen gas ambient atmosphere furnace, the mixed-gas ambient atmosphere furnace of nitrogen and hydrogen, a non-oxidizing atmosphere furnace, a vacuum furnace, etc. are used for said degassing processing.

[0013] In this invention, the reason for specifying the programming rate in said degassing processing at 200 degrees C or less per hour is for the plating liquid which permeated aluminum radical composite to evaporate rapidly, and for

bulging to arise in a plating layer, when it exceeds 200 degrees C. Moreover, the reason for specifying whenever [in said degassing processing / stoving temperature] at 200-500 degrees C is for aluminum radical composite's deteriorating at the temperature which the plating liquid which permeated aluminum radical composite at less than 200 degrees C is not removed, but exceeds 500 degrees C, or beginning to melt. Moreover, since there is a possibility that a surface layer may deteriorate when the temperature taken out from a furnace exceeds 100 degrees C, it is good to cool in a furnace to the temperature of 100 degrees C or less. The reason for performing said degassing processing in a reducing atmosphere, a non-oxidizing atmosphere, or a vacuum is for preventing oxidation of surface layers, such as a nickel-Co alloy layer, and deterioration.

[0014] The substrate layer and surface layer on said aluminum radical composite are possible also for that it is simple to form by the wet galvanizing methods, such as the electrolysis galvanizing method and a nonelectrolytic plating method, and forming with PVD, a CVD method, etc. by low cost, although it is desirable, and its degassing processing is unnecessary in this case.

[0015]

[Example] An example explains this invention below at a detail.

(Example 1) Electrolysis plating of the nickel layer was carried out as a substrate layer at the aluminum radical composite (3mm in thickness, width of face of 90mm, die length of 150mm) which scattered carbon fiber to the aluminum-20wt%Si alloy by 35vol(s)%, and electrolysis plating of a nickel-Co alloy layer, a nickel-Co-B alloy layer, or the nickel-B alloy layer was carried out as a surface layer on it. Subsequently, after rinsing, degassing processing was carried out and the base plate for the electronic equipment made from aluminum radical composite was manufactured. said substrate layer and a surface layer -- plating thickness -- within this invention convention, degassing processing conditions were boiled variously and changed. The detail of a production process is shown below. A supersonic wave is given for aluminum radical composite in trichlene.

cleaning -> ethanol washing (10-second immersion) -- the activation
(HNO₃400ml/l. -- the KOKEISAN EX100g/l. made from + KIZAI --) by the etching
-> rinsing -> acid by the -> rinsing -> alkali water solution (NaOH30g/l.) To
*****, 30 second immersion -> rinsing -> zincate processing -> rinsing -> acid-
washing (immersed in HNO₃500ml/l. water solution) -> rinsing -> zincate
processing (immersed in super zincate SZ made from KIZAI for 15 seconds) ->
rinsing ->nickel electrolysis plating -> rinsing -> A nickel-Co alloy, (It is immersed
in the super zincate SZ made from KIZAI for 30 seconds) A nickel-Co-B alloy or
nickel-B alloy electrolysis plating -> rinsing -> degassing processing according in
the inside of distilled water to a ultrasonic-cleaning -> ethanol washing ->
desiccation -> hydrogen gas furnace. Each plating conditions of said nickel, a
nickel-Co alloy, a nickel-Co-B alloy, and a nickel-B alloy and the conditions of
degassing processing are as follows.

[nickel electrolysis plating]

Plating liquid: NiSO₄240g/l., NiCl₂ 45g/l., H₃ BO₃ 30g/l., an additive A-1
(10ml/(l.)), A-2 (A-1 and A-2 are a product made from Kamimura Industry)
(1ml/(l.)).

Plating conditions: Resistance-welding-time 12 minutes at the time of 10
micrometers in 5 A/dm², 55 degrees C of solution temperature, and plating
thickness.

[nickel-Co alloy electrolysis plating]

Plating liquid: NiSO₄180g/l., CoSO₄ 60g/l., NiCl₂ 45g/l., H₃ BO₄ 30g/l.

Plating conditions: Resistance-welding-time 30 seconds at the time of 0.5
micrometers in 5 A/dm², 55 degrees C of solution temperature, and plating
thickness.

[nickel-Co-B alloy nonelectrolytic plating]

Plating liquid: NiCl₂ 10g/l., CoCl₂ 45g/l., NH₄ Cl12g/l., 4 (C two H5) NBr45g/l.,
NH₃ 160cc/l., NaBH₄1g/l.

Plating conditions: It is immersion time amount 10 minutes at the time of 0.5
micrometers in immersion and plating thickness in liquid with a temperature of

40-45 degrees C.

[nickel-B alloy electrolysis plating]

Plating liquid: NiSO₄ 240g/l. NiCl₂ 45g/l., H₃ BO₄ 30g/l., trimethylamine borane 3g/l.

Plating conditions: Resistance-welding-time 3 minutes at the time of 0.5 micrometers in 1 A/dm², 55 degrees C of solution temperature, and plating thickness.

[Degassing processing] 100% hydrogen gas ambient atmosphere furnace use, the programming rate of 50 degrees C/hour, the retention temperature of 300 degrees C, the holding time It is furnace cooling to 1 hour and 80 degrees C.

[0016] (Example 1 of a comparison) Substrate layer thickness, surface layer thickness, and degassing processing conditions were made into the outside of this invention convention, and also the electronic equipment base plate made from aluminum radical composite was manufactured by the same approach as an example 1.

[0017] About each nickel plating aluminum radical composite manufactured in the example 1 or the example 1 of a comparison, whenever [solder divergence and solder wetting angle] was measured, and comprehensive evaluation of the soldering nature was carried out. Measurement with the same said of the conventional material which galvanized nickel, and evaluation were performed. In addition, solder divergence carried plate solder on nickel plating aluminum radical composite, all over 100% hydrogen gas ambient atmosphere furnace, heated this in the programming rate of 40 degrees C / hr, and 300 degrees-C x 30 minutes of heating conditions, and *(ed) and asked for it in the solder area before heating the solder area after heating. The Pb-50wt%Sn alloy with the thickness of 0.2mm, a width of face [of 16mm], and a die length of 30mm was used for said plate solder. Moreover, whenever [wetting angle / of solder] expressed melting solder with the average of the include angles alpha and beta to which the front face of a sink and both the edges of the longitudinal section of the arbitration passing through the core of the solder 4 after coagulation makes

with nickel plating layer 2 front face on the surface layer 3 formed through the substrate layer 2 on the aluminum radical composite 1, as shown in drawing 1 .

In the acceptance standard, solder divergence made whenever [1-1.5, and solder wetting angle] 30 or less degrees. A result is shown in Tables 1-3.

[0018]

[Table 1]

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------|----|-------------------|-------------------|-------|-------|------|
| 本発明例 | 1 | Ni 3 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 2 | Ni 5 | Ni-Co 0.5 | 1.2 ○ | 24° ○ | ○ |
| | 3 | Ni 10 | Ni-Co 0.5 | 1.2 ○ | 24° ○ | ○ |
| | 4 | Ni 15 | Ni-Co 0.5 | 1.2 ○ | 25° ○ | ○ |
| | 5 | Ni 20 | Ni-Co 0.5 | 1.2 ○ | 25° ○ | ○ |
| | 6 | Ni 10 | Ni-Co 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 7 | Ni 10 | Ni-Co 0.02 | 1.1 ○ | 26° ○ | ○ |
| | 8 | Ni 10 | Ni-Co 0.1 | 1.1 ○ | 25° ○ | ○ |
| | 9 | Ni 10 | Ni-Co 1 | 1.2 ○ | 25° ○ | ○ |
| | 10 | Ni 10 | Ni-Co 3 | 1.4 ○ | 22° ○ | ○ |
| | 11 | Ni 10 | Ni-Co 5 | 1.4 ○ | 23° ○ | ○ |

[0019]

[Table 2]

| | No | 下地層 | μm | 表面層 | μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-----|---------------|---------|---------------|-------|-------|------|
| 本 発 明 例 | 12 | Ni | 10 | Ni-Co-B | 0.01 | 1.0 ○ | 27° ○ | ○ |
| | 13 | Ni | 10 | Ni-Co-B | 0.02 | 1.1 ○ | 25° ○ | ○ |
| | 14 | Ni | 10 | Ni-Co-B | 0.1 | 1.1 ○ | 24° ○ | ○ |
| | 15 | Ni | 10 | Ni-Co-B | 1 | 1.2 ○ | 24° ○ | ○ |
| | 16 | Ni | 10 | Ni-Co-B | 3 | 1.4 ○ | 20° ○ | ○ |
| | 17 | Ni | 10 | Ni-Co-B | 5 | 1.4 ○ | 22° ○ | ○ |
| | 18 | Ni | 10 | Ni-B | 0.01 | 1.0 ○ | 27° ○ | ○ |
| | 19 | Ni | 10 | Ni-B | 0.02 | 1.1 ○ | 26° ○ | ○ |
| | 20 | Ni | 10 | Ni-B | 0.1 | 1.1 ○ | 25° ○ | ○ |
| | 21 | Ni | 10 | Ni-B | 1 | 1.2 ○ | 24° ○ | ○ |
| | 22 | Ni | 10 | Ni-B | 3 | 1.4 ○ | 23° ○ | ○ |
| | 23 | Ni | 10 | Ni-B | 5 | 1.4 ○ | 22° ○ | ○ |

[0020]

[Table 3]

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|-----|----|-------------------|-------------------|-------|-------|------|
| 比較例 | 24 | Ni 1 | Ni-Co 0.5 | 0.5 × | 45° × | × |
| | 25 | Ni 2 | Ni-Co 0.5 | 0.6 × | 42° × | × |
| | 26 | Ni 10 | Ni-Co 0.008 | 0.8 × | 37° × | × |
| | 27 | Ni 10 | Ni-Co-B 0.008 | 0.9 × | 35° × | × |
| | 28 | Ni 10 | Ni-B 0.008 | 0.7 × | 44° × | × |
| 従来 | 29 | Ni 10 | なし | 0.5 × | 55° × | × |

[0021] It was what whenever [divergence / of solder / (solder wettability) and wetting angle / of solder] satisfies an acceptance standard, and is synthetically excellent in each No.1-23 of the example of this invention (example 1) so that more clearly than Tables 1-3. A surface layer seems moreover, to have not exfoliated. On the other hand, example 1 of a comparison No.24-28 and No.29 of the conventional material It was what whenever [divergence / of solder / (solder wettability) and wetting angle / of solder] is less than an acceptance standard, and is synthetically inferior in each. moreover, No. -- exfoliation was accepted partially [24 and 25] to a surface layer. This is because the substrate layer was thin.

[0022] (Example 2) Aluminum radical composite which scattered SiC fiber to the aluminum-12wt%Si-1wt%Mg-1wt%Cu alloy by 60vol(s)% (3mm in thickness) Nonelectrolytic plating of the nickel-5wt%P alloy was carried out to width of face of 90mm, and 150mm long, electrolysis plating of a nickel-Co alloy, a nickel-Co-B alloy, or the nickel-B alloy was carried out on it, degassing processing was carried out at the last, and the base plate for the electronic equipment made from aluminum radical composite was manufactured. a substrate layer and a surface layer -- plating thickness -- and within this invention convention, degassing processing conditions were boiled variously and changed. nickel-5wt% -- it

manufactured by the same approach as an example 1 except P alloy plating. The nonelectrolytic plating conditions of a nickel-P alloy are shown below.

[nickel-P alloy nonelectrolytic plating]

Plating liquid: DX-M made from Kamimura Industry (100ml/(l.)), and DX-A (50ml/(l.)).

Plating conditions: Immersion time amount 30 minutes at the time of 10 micrometers in 90 degrees C of solution temperature, and plating thickness.

[0023] (Example 2 of a comparison) The plating thickness of a substrate layer and a surface layer and degassing processing conditions were made into the outside of this invention convention, and also the electronic equipment base plate made from aluminum radical composite was manufactured by the same approach as an example 2.

[0024] About each nickel plating aluminum radical composite manufactured in the example 2 or the example 2 of a comparison, whenever [solder divergence and solder wetting angle] was measured, and comprehensive evaluation of the soldering nature was carried out. Measurement with the same said of the conventional material which galvanized nickel, and evaluation were performed. In addition, solder divergence carried plate solder on nickel plating aluminum radical composite, all over the mixed-gas furnace (nitrogen 90vol% and hydrogen 10vol%), heated this in the programming rate of 40 degrees C / hr, and 400 degrees-C x 30 minutes of heating conditions, and ** (ed) and asked for it in the solder area before heating the solder area after heating cooling. The Zn-10wt%aluminum alloy with the thickness of 0.2mm, a width of face [of 16mm], and a die length of 30mm was used for said plate solder. Moreover, the same approach as an example 1 measured and estimated whenever [wetting angle / of solder]. In the acceptance standard, solder divergence made whenever [1-1.5, and solder wetting angle] 30 or less degrees. A result is shown in Tables 4-6.

[0025]

[Table 4]

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-------------------|-------------------|-------|-------|------|
| 本 発 明 例 | 41 | Ni-P 3 | Ni-Co 0.5 | 1.0 ○ | 27° ○ | ○ |
| | 42 | Ni-P 5 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 43 | Ni-P 10 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 44 | Ni-P 15 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 45 | Ni-P 20 | Ni-Co 0.5 | 1.2 ○ | 26° ○ | ○ |
| | 46 | Ni-P 10 | Ni-Co 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 47 | Ni-P 10 | Ni-Co 0.02 | 1.1 ○ | 27° ○ | ○ |
| | 48 | Ni-P 10 | Ni-Co 0.1 | 1.2 ○ | 26° ○ | ○ |
| | 49 | Ni-P 10 | Ni-Co 1 | 1.1 ○ | 26° ○ | ○ |
| | 50 | Ni-P 10 | Ni-Co 3 | 1.3 ○ | 24° ○ | ○ |
| | 51 | Ni-P 10 | Ni-Co 5 | 1.3 ○ | 24° ○ | ○ |

[0026]

[Table 5]

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-------------------|-------------------|-------|-------|------|
| 本 発 明 例 | 52 | Ni-P 10 | Ni-Co-B 0.01 | 1.1 ○ | 28° ○ | ○ |
| | 53 | Ni-P 10 | Ni-Co-B 0.02 | 1.0 ○ | 27° ○ | ○ |
| | 54 | Ni-P 10 | Ni-Co-B 0.1 | 1.1 ○ | 26° ○ | ○ |
| | 55 | Ni-P 10 | Ni-Co-B 1 | 1.1 ○ | 26° ○ | ○ |
| | 56 | Ni-P 10 | Ni-Co-B 3 | 1.2 ○ | 23° ○ | ○ |
| | 57 | Ni-P 10 | Ni-Co-B 5 | 1.2 ○ | 23° ○ | ○ |
| | 58 | Ni-P 10 | Ni-B 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 59 | Ni-P 10 | Ni-B 0.02 | 1.1 ○ | 28° ○ | ○ |
| | 60 | Ni-P 10 | Ni-B 0.1 | 1.1 ○ | 27° ○ | ○ |
| | 61 | Ni-P 10 | Ni-B 1 | 1.1 ○ | 26° ○ | ○ |
| | 62 | Ni-P 10 | Ni-B 3 | 1.2 ○ | 26° ○ | ○ |
| | 63 | Ni-P 10 | Ni-B 5 | 1.3 ○ | 25° ○ | ○ |

[0027]

[Table 6]

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|-----|----|-------------------|-------------------|-------|-------|------|
| 比較例 | 64 | Ni-P 1 | Ni-Co 0.5 | 0.5 × | 47° × | × |
| | 65 | Ni-P 2 | Ni-Co 0.5 | 0.5 × | 45° × | × |
| | 66 | Ni-P 10 | Ni-Co 0.008 | 0.7 × | 40° × | × |
| | 67 | Ni-P 10 | Ni-Co-B 0.008 | 0.8 × | 39° × | × |
| | 68 | Ni-P 10 | Ni-B 0.008 | 0.6 × | 47° × | × |
| 従来 | 69 | Ni 10 | なし | 0.5 × | 55° × | × |

[0028] It is an example of this invention (example 2) so that more clearly than Tables 4-6. No.41-63 were what bulging of a plating layer is not accepted, and satisfies the acceptance standard of the breadth of solder, and is synthetically excellent in soldering nature. A surface layer seems moreover, to have not exfoliated. On the other hand, example 2 of a comparison No.64-68 and the conventional material Each No.69 was less than the acceptance standard, and soldering nature was synthetically inferior. moreover, No. -- exfoliation was accepted partially [64 and 65] to a surface layer. This is because the substrate layer was thin.

[0029]

[Effect of the Invention] As stated above, the base plate for the electronic equipment made from aluminum radical composite of this invention Since substrate plating of the nickel layer is carried out on aluminum radical composite at proper thickness and the surface layer of a nickel-Co alloy layer, a nickel-Co-B alloy layer, or a nickel-B alloy layer is galvanized by proper thickness on it Said surface layer is stuck to aluminum radical composite good, and excessive solder breadth is controlled and said surface layer can plan cost reduction in the reduction list of a soldering man day, in obtaining good soldering nature, in order to show moderate solder wettability. Moreover, the base plate of said this

invention can be easily manufactured by performing degassing processing on a reducing atmosphere, a non-oxidizing atmosphere, or heating conditions predetermined in the inside of a vacuum, after galvanizing a substrate layer and a surface layer in predetermined thickness. Therefore, it is useful to the substrate of the mass IGBT module which is easy to generate heat etc., and remarkable effectiveness is done so on industry.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view of whenever [wetting angle / of solder].

[Description of Notations]

- 1 Aluminum Radical Composite
- 2 Substrate Layer
- 3 Surface Layer
- 4 Solder after Coagulation

nickel plating layer front face on the front face of a edge of the solder after alpha and beta coagulation, and the include angle to make

[Translation done.]

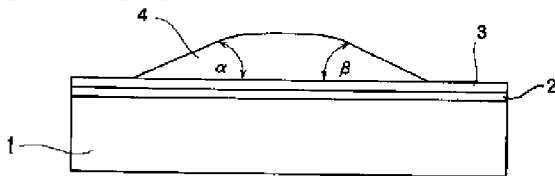
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DRAWINGS

[Drawing 1]



[Translation done.]

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最終頁に続く

(54) 【発明の名称】 N i めっきアルミ基複合材製電子機器用ベース板およびその製造方法

(57) 【要約】

【課題】 良好な半田付性が得られかつ余分に半田が広がらない、適度な半田濡れ性を示すN i めっきアルミ基複合材製電子機器用ベース板を提供する。

【解決手段】 アルミ基複合材上に下地層としてN i 金属層またはN i - P 合金層が厚さ3 μ m以上にめっきされ、その上に表面層としてN i - C o 合金層、N i - C o - B 合金層、またはN i - B 合金層のうちの少なくとも1層が厚さ0.01 μ m以上にめっきされている。

【特許請求の範囲】

【請求項1】 アルミ基複合材上に下地層としてNi金属層またはNi-P合金層が厚さ $3\mu\text{m}$ 以上にめっきされ、その上に表面層としてNi-C合金層、Ni-C-B合金層、またはNi-B合金層のうちの少なくとも1層が厚さ $0.01\mu\text{m}$ 以上にめっきされていることを特徴とするNiめっきアルミ基複合材製電子機器用ベース板。

【請求項2】 アルミ基複合材上に下地層としてNi金属層またはNi-P合金層を厚さ $3\mu\text{m}$ 以上にめっきし、その上に表面層としてNi-C合金層、Ni-C-B合金層またはNi-B合金層のうちの少なくとも1層を厚さ $0.01\mu\text{m}$ 以上にめっきし、次いで還元性雰囲気、非酸化性雰囲気、または真空中で、1時間あたり 200°C 以下の昇温速度で加熱して $200\sim 500^{\circ}\text{C}$ の温度に所定時間保持する脱気処理を施すことを特徴とするアルミ基複合材製電子機器用ベース板の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、良好な半田付性が得られかつ余分に半田が広がらない、適度な半田濡れ性を示すNiめっきアルミ基複合材製電子機器用ベース板およびその製造方法に関する。

【0002】

【従来の技術】アルミ基複合材は、アルミニウムまたはアルミニウム合金に繊維状または粒子状のセラミックスやカーボンなどを分散させた複合材で、従来より強度や耐磨耗性を要する分野に用いられてきたが、最近、その低熱膨張性、高熱伝導性の特長を生かして発熱し易い大容量IGBT(Insulated Gate Bipolar Transister)モジュールの基板などにも採用されだした。ところで、前記基板にはSiチップなどを搭載したDBC基板(Direct Bonding Copper:セラミックス板にCuを被覆した基板)が半田付けされるが、アルミ基複合材は半田付性が悪いいため、アルミ基複合材の半田付部分にNiをめっきして半田付性を改善している(特開平5-86481号公報)。

【0003】しかし、前記Niめっき層は、大気中に1週間程度放置しておくとも半田付けに有害な酸化皮膜が生成するが、この酸化皮膜は半田付け時に塗布する塩素系フラックスにより除去され、半田付けはほぼ良好になされる。ところで、近年、環境保護の面から、前記塩素系フラックスは使用が控えられる傾向にあり、それに代わって低塩素系フラックスや松脂を主成分とするフラックスが用いられるようになり、さらには、フラックスを用いずに、水素ガス雰囲気炉、窒素と水素の混合ガス雰囲気炉、または不活性ガス雰囲気炉中で半田付けするノンフラックス半田付法が開発されている。

【0004】

【発明が解決しようとする課題】しかし、前記ノンフラ

ックス半田付法には、塩素系フラックスほどの脱酸作用がないため少しでも酸化皮膜が存在すると半田濡れ性が低下して半田付性が悪化するという問題がある。例えば、実際に工場で、Niめっきアルミ基複合材を大気中に1週間放置したのち、DBC基板を共品はんだ(Sn-37wt%Pb)を用い還元性雰囲気(水素-10vol%窒素)炉内で半田付けすると、非接合(濡れない)箇所やフィレット(半田の肉盛り部分)が形成されない箇所が生じたりする。このため半田濡れ性の良い表面処理方法が盛んに研究されている。一方、半田濡れ性が良すぎる場合は、半田を無用とする領域にまで半田が広がって外観不良や機能の低下を招くため、レジスト(エポキシ樹脂など)でマスクして半田の広がりを抑えており、生産性が阻害されるという問題がある。

【0005】このようなことから、本発明者等はノンフラックス半田付法においても良好な半田付性が得られかつ余分に半田が広がらない、適度な半田濡れ性を示すアルミ基複合材の表面処理方法について研究を行い、その結果アルミ基複合材に所定のNi合金をめっきすることにより適度な半田濡れ性が得られることを知見し、さらに研究を進めて本発明を完成させるに至った。本発明は、良好な半田付性が得られかつ余分に半田が広がらない、適度な半田濡れ性を示すNiめっきアルミ基複合材製電子機器用ベース板およびその製造方法の提供を目的とする。

【0006】

【課題を解決するための手段】請求項1記載の発明は、アルミ基複合材上に下地層としてNi金属層またはNi-P合金層が厚さ $3\mu\text{m}$ 以上にめっきされ、その上に表面層としてNi-C合金層、Ni-C-B合金層、またはNi-B合金層のうちの少なくとも1層が厚さ $0.01\mu\text{m}$ 以上にめっきされていることを特徴とするNiめっきアルミ基複合材製電子機器用ベース板である。

【0007】請求項2記載の発明は、アルミ基複合材上に下地層としてNi金属層またはNi-P合金層を厚さ $3\mu\text{m}$ 以上にめっきし、その上に表面層としてNi-C合金層、Ni-C-B合金層またはNi-B合金層のうちの少なくとも1層を厚さ $0.01\mu\text{m}$ 以上にめっきし、次いで還元性雰囲気、非酸化性雰囲気、または真空中で、1時間あたり 200°C 以下の昇温速度で加熱して $200\sim 500^{\circ}\text{C}$ の温度に所定時間保持する脱気処理を施すことを特徴とするアルミ基複合材製電子機器用ベース板の製造方法である。

【0008】

【発明の実施の形態】請求項1記載の発明において、アルミ基複合材上にめっきされるNi金属またはNi-P合金の下地層は、表面層のアルミ基複合材との密着性を高め、さらにアルミ基複合材全面にめっきすることによりアルミ基複合材の耐食性を改善する。また前記表面層

は、Ni-Co合金層、Ni-Co-B合金層、またはNi-B合金層の少なくとも1種から構成され、いずれの合金層も良好な半田付性が得られかつ余分に半田が広がらない、適度な半田濡れ性を示すものである。

【0009】前記下地層のNi-P合金層のPの含有量は5～15wt%において、その下地層としての効果が最も良く発揮される。また表面層のNi-Co合金層、Ni-Co-B合金層またはNi-B合金層におけるCo、Bの含有量は、それぞれ10～30wt%、1～5wt%において表面層としての効果が最も良く発揮される。

【0010】この発明において、前記下地層の厚さを3μm以上に規定する理由は、3μm未満ではアルミ基複合材の素地が露出する場合があります下地層としての役目を果たさなくなる恐れがあるため、特に5μm以上の厚さが望ましい。一方、下地層が厚すぎると熱抵抗が増加して放熱性が低下し、またコストアップの原因にもなるので20μm以下が望ましい。この発明において、前記表面層の厚さを0.01μm以上に規定する理由は、0.01μm未満ではその効果が十分に得られないため、特に望ましい厚さは0.02μm以上である。表面層の厚さは5μmより厚くてもその効果が飽和し不経済であり、5μm以下が望ましい。前記表面層は複数の合金層で形成しても同様の効果が得られる。また下層はNi金属層およびNi-P合金層で形成しても差し支えない。

【0011】この発明において、アルミ基複合材のマトリックスとなるアルミには、純Al、またはAl-Si合金、Al-Mg合金など任意のアルミ合金が用いられ、また分散材にはSiC、AlN、ZrO₂、Si₃N₄、SiO₂などのセラミックス、またはカーボンなどの繊維または粒子が用いられ、前記Al合金と分散材の組合わせは任意である。前記アルミ基複合材は熱伝導性に優れ、また熱膨張係数が小さいため電子機器ベース板として用いた場合に、電子機器の発熱が良好に放散される。特に、Al-Si合金とカーボン繊維は熱膨張係数がともに小さく、かつ相互に近似しているため、両者により構成されるAl基複合材はAlマトリックスと分散材との間に剥がれが生じ難くアルミ基複合材の信頼性が高い。またAl-Si合金は湯流れ性が良いため高品質なアルミ基複合材が得られる。熱膨張係数が小さい分散材としては、カーボン繊維(粒子)の他、SiC、AlN、ZrO₂などの繊維(粒子)が挙げられる。

【0012】請求項2記載の発明は、アルミ基複合材上に下地層および表面層をめっきしたのち、還元性雰囲気、非酸化性雰囲気、または真空中で所定の加熱条件で脱気処理する(即ち、アルミ基複合材に浸透しためっき液などを除去する)Niめっきアルミ基複合材製電子機器用ベース板の製造方法で、この製造方法によれば、表面層が変質せず、適度な半田濡れ性が得られる。前記脱気処理には、水素ガス雰囲気炉、窒素と水素の混合ガス

雰囲気炉、非酸化性雰囲気炉、真空炉などが用いられる。

【0013】この発明において、前記脱気処理での昇温速度を1時間あたり200℃以下に規定する理由は、200℃を超えるとアルミ基複合材に浸透しためっき液などが急激に蒸発してめっき層に膨れが生じるためである。また前記脱気処理での加熱温度を200～500℃に規定する理由は、200℃未満ではアルミ基複合材に浸透しためっき液などが除去されず、500℃を超える温度ではアルミ基複合材が変質したり、溶けだしたりするためである。また炉から取出す温度が100℃を超えると、表面層が変質したりする恐れがあるため、100℃以下の温度まで炉内冷却するのが良い。前記脱気処理を還元性雰囲気、非酸化性雰囲気、または真空中で行う理由は、Ni-Co合金層などの表面層の酸化、変質を防止するためである。

【0014】前記アルミ基複合材上の下地層および表面層は、電解めっき法、無電解めっき法などの湿式めっき法により形成するのが簡便かつ低コストで望ましいが、PVD法、CVD法などにより形成することも可能で、この場合は脱気処理が不要である。

【0015】

【実施例】以下に本発明を実施例により詳細に説明する。

(実施例1) Al-20wt% Si合金にカーボン繊維を35vol%分散させたアルミ基複合材(厚さ3mm、幅90mm、長さ150mm)に下地層としてNi層を電解めっきし、その上に表面層としてNi-Co合金層、Ni-Co-B合金層またはNi-B合金層を電解めっきした。次いで、水洗後、脱気処理してアルミ基複合材製電子機器用ベース板を製造した。前記下地層および表面層のめっき厚さ、脱気処理条件は、本発明規定内で種々に変化させた。製造工程の詳細を下記に示す。アルミ基複合材をトリクレン中で超音波を付与して脱脂→エタノール洗浄(10秒浸漬)→水洗→アルカリ水溶液(NaOH30g/)によるエッチング→水洗→酸による活性化処理(HNO₃400ml/ +キザイ(株)製コケイサンEX100g/)の水溶液に30秒浸漬)→水洗→ジンケート処理(キザイ(株)製スーパージンケートSZに30秒浸漬)→水洗→酸洗(HNO₃500ml/ 水溶液に浸漬)→水洗→ジンケート処理(キザイ(株)製スーパージンケートSZに15秒浸漬)→水洗→Ni電解めっき→水洗→Ni-Co合金、Ni-Co-B合金またはNi-B合金電解めっき→水洗→蒸留水中で超音波洗浄→エタノール洗浄→乾燥→水素ガス炉による脱気処理。前記Ni、Ni-Co合金、Ni-Co-B合金、Ni-B合金の各めっき条件、および脱気処理の条件は下記の通りである。

〔Ni電解めっき〕

めっき液: NiSO₄240g/ 、NiCl₂45g/ 、H₃BO₃30g/ 、添加剤A-1(10ml/)、A-2

(1ml/) (A-1, A-2 は上村工業 (株) 製)。

めっき条件: 5 A/dm^2 、液温 55°C 、めっき厚さ $10\text{ }\mu\text{m}$ のときの通電時間 12 分。

〔Ni-Co 合金電解めっき〕

めっき液: NiSO_4 180g/、 CoSO_4 60g/、 NiCl_2 45g/、 H_3BO_4 30g/。

めっき条件: 5 A/dm^2 、液温 55°C 、めっき厚さ $0.5\text{ }\mu\text{m}$ のときの通電時間 30 秒。

〔Ni-Co-B 合金無電解めっき〕

めっき液: NiCl_2 10g/、 CoCl_2 45g/、 NH_4Cl 12g/、 $(\text{C}_2\text{H}_5)_4\text{NBr}$ 45g/、 N_2H_4 160cc/、 NaBH_4 1g/。

めっき条件: 温度 $40\sim 45^\circ\text{C}$ の液中に浸漬、めっき厚さ $0.5\text{ }\mu\text{m}$ のときの浸漬時間 10 分。

〔Ni-B 合金電解めっき〕

めっき液: NiSO_4 240g/、 NiCl_2 45g/、 H_3BO_4 30g/、トリメチルアミンボラン 3g/。

めっき条件: 1 A/dm^2 、液温 55°C 、めっき厚さ $0.5\text{ }\mu\text{m}$ のときの通電時間 3 分。

〔脱気処理〕100% 水素ガス雰囲気炉使用、昇温速度 50°C/時間 、保持温度 300°C 、保持時間 1 時間、 80°C まで炉冷。

【0016】(比較例 1) 下地層厚さ、表面層厚さ、脱気処理条件を、本発明規定外とした他は、実施例 1 と同じ方法によりアルミ基複合材製電子機器ベース板を製造した。

【0017】実施例 1 または比較例 1 で製造した各々の Ni めっきアルミ基複合材について、半田広がり比および半田濡れ角度を測定して半田付性を総合評価した。Ni をめっきしただけの従来材についても同様の測定、評価を行った。なお、半田広がり比は、Ni めっきアルミ基複合材上に板半田を載せ、これを 100% 水素ガス雰囲気炉中で、昇温速度 40°C/hr 、加熱条件 $300^\circ\text{C} \times 30$ 分で加熱し、加熱後の半田面積を加熱前の半田面積で除して求めた。前記板半田には、厚さ 0.2 mm 、幅 16 mm 、長さ 30 mm の Pb-50wt% Sn 合金を用いた。また半田の濡れ角度は、図 1 に示すように、アルミ基複合材 1 上に、下地層 2 を介して形成された表面層 3 上に熔融半田を流し、凝固後の半田 4 の中心を通る任意の縦断面の両縁部の表面が Ni めっき層 2 表面となす角度 α と β の平均値で表した。合格基準は、半田広がり比は 1~1.5、半田濡れ角度は 30 度以下とした。結果を表 1~3 に示す。

【0018】

【表 1】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-------------------|-------------------|-------|--------------|------|
| 本 発 明 例 | 1 | Ni 3 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 2 | Ni 5 | Ni-Co 0.5 | 1.2 ○ | 24° ○ | ○ |
| | 3 | Ni 10 | Ni-Co 0.5 | 1.2 ○ | 24° ○ | ○ |
| | 4 | Ni 15 | Ni-Co 0.5 | 1.2 ○ | 25° ○ | ○ |
| | 5 | Ni 20 | Ni-Co 0.5 | 1.2 ○ | 25° ○ | ○ |
| | 6 | Ni 10 | Ni-Co 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 7 | Ni 10 | Ni-Co 0.02 | 1.1 ○ | 26° ○ | ○ |
| | 8 | Ni 10 | Ni-Co 0.1 | 1.1 ○ | 25° ○ | ○ |
| | 9 | Ni 10 | Ni-Co 1 | 1.2 ○ | 25° ○ | ○ |
| | 10 | Ni 10 | Ni-Co 3 | 1.4 ○ | 22° ○ | ○ |
| | 11 | Ni 10 | Ni-Co 5 | 1.4 ○ | 23° ○ | ○ |

【0019】

【表 2】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-------------------|-------------------|-------|-------|------|
| 本 発 明 例 | 12 | Ni 10 | Ni-Co-B 0.01 | 1.0 ○ | 27° ○ | ○ |
| | 13 | Ni 10 | Ni-Co-B 0.02 | 1.1 ○ | 25° ○ | ○ |
| | 14 | Ni 10 | Ni-Co-B 0.1 | 1.1 ○ | 24° ○ | ○ |
| | 15 | Ni 10 | Ni-Co-B 1 | 1.2 ○ | 24° ○ | ○ |
| | 16 | Ni 10 | Ni-Co-B 3 | 1.4 ○ | 20° ○ | ○ |
| | 17 | Ni 10 | Ni-Co-B 5 | 1.4 ○ | 22° ○ | ○ |
| | 18 | Ni 10 | Ni-B 0.01 | 1.0 ○ | 27° ○ | ○ |
| | 19 | Ni 10 | Ni-B 0.02 | 1.1 ○ | 26° ○ | ○ |
| | 20 | Ni 10 | Ni-B 0.1 | 1.1 ○ | 25° ○ | ○ |
| | 21 | Ni 10 | Ni-B 1 | 1.2 ○ | 24° ○ | ○ |
| | 22 | Ni 10 | Ni-B 3 | 1.4 ○ | 23° ○ | ○ |
| | 23 | Ni 10 | Ni-B 5 | 1.4 ○ | 22° ○ | ○ |

【0020】

【表3】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|-------------|----|-------------------|-------------------|-------|-------|------|
| 比 較 例 | 24 | Ni 1 | Ni-Co 0.5 | 0.5 × | 45° × | × |
| | 25 | Ni 2 | Ni-Co 0.5 | 0.6 × | 42° × | × |
| | 26 | Ni 10 | Ni-Co 0.008 | 0.8 × | 37° × | × |
| | 27 | Ni 10 | Ni-Co-B 0.008 | 0.9 × | 35° × | × |
| | 28 | Ni 10 | Ni-B 0.008 | 0.7 × | 44° × | × |
| 従 来 | 29 | Ni 10 | なし | 0.5 × | 55° × | × |

【0021】表1～3より明らかなように、本発明例（実施例1）のNo.1～23は、いずれも半田の広がり比（半田濡れ性）および半田の濡れ角度が合格基準を満足し、総合的に優れるものであった。また表面層が剥離するようなこともなかった。これに対し、比較例1のNo.24～28、従来材のNo.29は、いずれも半田の広がり比（半田濡れ性）および半田の濡れ角度が合格基準を下回り、総合的に劣るものであった。またNo.24,25は表面層

に部分的に剥離が認められた。これは下地層が薄かったためである。

【0022】（実施例2）Al-12wt%Si-1wt%Mg-1wt%Cu合金にSiC繊維を60vol%分散させたアルミ基複合材（厚さ3mm、幅90mm、縦150mm）にNi-5wt%P合金を無電解めっきし、その上にNi-Co合金、Ni-Co-B合金、またはNi-B合金を電解めっきし、最後に脱気処理してアルミ基複

合材製電子機器用ベース板を製造した。下地層および表面層のめっき厚さ、および脱気処理条件は、本発明規定内で種々に変化させた。Ni-5wt%P合金めっき以外は実施例1と同じ方法により製造した。Ni-P合金の無電解めっき条件を下記に示す。

〔Ni-P合金無電解めっき〕

めっき液：上村工業（株）製DX-M(100ml/)、DX-A(50ml/)。

めっき条件：液温90℃、めっき厚さ10μmのときの浸漬時間30分。

【0023】（比較例2）下地層および表面層のめっき厚さ、および脱気処理条件を、本発明規定外とした他は、実施例2と同じ方法によりアルミ基複合材製電子機器ベース板を製造した。

【0024】実施例2または比較例2で製造した各々の

Niめっきアルミ基複合材について、半田広がり比および半田濡れ角度を測定して半田付性を総合評価した。Niをめっきしただけの従来材についても同様の測定、評価を行った。なお、半田広がり比は、Niめっきアルミ基複合材上に板半田を載せ、これを窒素90vol%と水素10vol%の混合ガス炉中で、昇温速度40℃/hr、加熱条件400℃×30分で加熱し、加熱冷却後の半田面積を加熱前の半田面積で除して求めた。前記板半田には、厚さ0.2mm、幅16mm、長さ30mmのZn-10wt%A1合金を用いた。また半田の濡れ角度は、実施例1と同じ方法により測定、評価した。合格基準は、半田広がり比は1～1.5、半田濡れ角度は30度以下とした。結果を表4～6に示す。

【0025】

【表4】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|---------|------------|-------|-------|------|
| 本 発 明 例 | 41 | Ni-P 3 | Ni-Co 0.5 | 1.0 ○ | 27° ○ | ○ |
| | 42 | Ni-P 5 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 43 | Ni-P 10 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 44 | Ni-P 15 | Ni-Co 0.5 | 1.1 ○ | 26° ○ | ○ |
| | 45 | Ni-P 20 | Ni-Co 0.5 | 1.2 ○ | 26° ○ | ○ |
| | 46 | Ni-P 10 | Ni-Co 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 47 | Ni-P 10 | Ni-Co 0.02 | 1.1 ○ | 27° ○ | ○ |
| | 48 | Ni-P 10 | Ni-Co 0.1 | 1.2 ○ | 26° ○ | ○ |
| | 49 | Ni-P 10 | Ni-Co 1 | 1.1 ○ | 26° ○ | ○ |
| | 50 | Ni-P 10 | Ni-Co 3 | 1.3 ○ | 24° ○ | ○ |
| | 51 | Ni-P 10 | Ni-Co 5 | 1.3 ○ | 24° ○ | ○ |

【0026】

【表5】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|------------------|----|-------------------|-------------------|-------|-------|------|
| 本 発 明 例 | 52 | Ni-P 10 | Ni-Co-B 0.01 | 1.1 ○ | 28° ○ | ○ |
| | 53 | Ni-P 10 | Ni-Co-B 0.02 | 1.0 ○ | 27° ○ | ○ |
| | 54 | Ni-P 10 | Ni-Co-B 0.1 | 1.1 ○ | 26° ○ | ○ |
| | 55 | Ni-P 10 | Ni-Co-B 1 | 1.1 ○ | 26° ○ | ○ |
| | 56 | Ni-P 10 | Ni-Co-B 3 | 1.2 ○ | 23° ○ | ○ |
| | 57 | Ni-P 10 | Ni-Co-B 5 | 1.2 ○ | 23° ○ | ○ |
| | 58 | Ni-P 10 | Ni-B 0.01 | 1.0 ○ | 28° ○ | ○ |
| | 59 | Ni-P 10 | Ni-B 0.02 | 1.1 ○ | 28° ○ | ○ |
| | 60 | Ni-P 10 | Ni-B 0.1 | 1.1 ○ | 27° ○ | ○ |
| | 61 | Ni-P 10 | Ni-B 1 | 1.1 ○ | 26° ○ | ○ |
| | 62 | Ni-P 10 | Ni-B 3 | 1.2 ○ | 26° ○ | ○ |
| | 63 | Ni-P 10 | Ni-B 5 | 1.3 ○ | 25° ○ | ○ |

【0027】

【表6】

| | No | 下地層 μm | 表面層 μm | 広がり比 | 濡れ角度 | 総合判定 |
|-------------|----|-------------------|-------------------|-------|-------|------|
| 比 較 例 | 64 | Ni-P 1 | Ni-Co 0.5 | 0.5 × | 47° × | × |
| | 65 | Ni-P 2 | Ni-Co 0.5 | 0.5 × | 45° × | × |
| | 66 | Ni-P 10 | Ni-Co 0.008 | 0.7 × | 40° × | × |
| | 67 | Ni-P 10 | Ni-Co-B 0.008 | 0.8 × | 39° × | × |
| | 68 | Ni-P 10 | Ni-B 0.008 | 0.6 × | 47° × | × |
| 従 来 | 69 | Ni 10 | なし | 0.5 × | 55° × | × |

【0028】表4～6より明らかなように、本発明例（実施例2）の No.41～63は、めっき層の膨れが認められず、また半田の広がり合格基準を満足し総合的に半田付性に優れるものであった。また表面層が剥離するようなこともなかった。これに対し、比較例2の No.64～68および従来材の No.69は、いずれも合格基準を下回り、半田付性は総合的に劣った。またNo.64,65は表面層に部分的に剥離が認められた。これは下地層が薄かった

ためである。

【0029】

【発明の効果】以上に述べたように、本発明のアルミ基複合材製電子機器用ベース板は、アルミ基複合材上にNi層が適正な厚さに下地めっきされ、その上にNi-Co合金層、Ni-Co-B合金層またはNi-B合金層の表面層が適正な厚さにめっきされているので、前記表面層はアルミ基複合材に良好に密着し、かつ前記表面層

は適度な半田濡れ性を示すため、良好な半田付性が得られるうえ、余分な半田広がりが抑制されて半田付け工数の削減並びにコスト低減が図れる。また前記本発明のベース板は、下地層および表面層を所定厚さにめっきしたのち、還元性雰囲気、非酸化性雰囲気、または真空中で所定の加熱条件で脱気処理を施すことにより容易に製造できる。依って、発熱し易い大容量 IGBT モジュールの基板などに有用で、工業上顕著な効果を奏する。

【図面の簡単な説明】

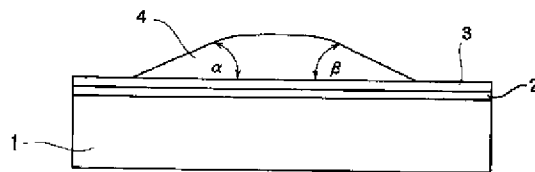
【図1】半田の濡れ角度の説明図である。

【符号の説明】

- 1 アルミ基複合材
- 2 下地層
- 3 表面層
- 4 凝固後の半田

α 、 β 凝固後の半田の縁部表面の Ni めっき層表面となす角度

【図1】



フロントページの続き

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